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SALMONELLA ENTERITIDIS OUTBREAK DUE TO CONTAMINATED CHEESE - NEWFOUNDLAND

A major Canada-wide outbreak of *Salmonella* Enteritidis (SE) associated with contaminated cheese in a commercial product occurred during March and April 1998. Nearly 700 reported cases, the majority of whom were children, were associated with the outbreak. This report describes the outbreak in Newfoundland.

On 20 March 1998, a St. John's hospital reported SE in three children (2, 10, and 15 years of age) with severe gastroenteritis; they had been seen in emergency the previous day. Earlier that day, the provincial Public Health Laboratory (PHL) in St. John's had confirmed a case of SE in a 7-year-old child with gastroenteritis; this child had been seen in Gander, about 300 km to the west. As the province of Newfoundland and Labrador averages no more than one case report of salmonellosis per week and the last case of SE occurred in August 1997, this number of cases was considered unusual. On 23 March 1998, six more cases of SE were confirmed. Except for one case, all were 15 years of age; four were from St. John's, one was from Labrador City, and one was from central Newfoundland. Health officials throughout the province were notified and an outbreak investigation began immediately. Laboratory Centre for Disease Control (LCDC) was notified of the outbreak on 25 March 1998. During a teleconference convened by LCDC on 26 March 1998, it was learned that Ontario was experiencing a similar outbreak. Phage typing results from the National Laboratory for Enteric Pathogens indicated all the Newfoundland outbreak isolates were phage type 8, suggesting a common source outbreak.

By 27 March 1998, prepackaged processed lunch packs were incriminated on the basis of the case food histories in Newfoundland. Laboratory tests conducted by the Canadian Food Inspection Agency incriminated cheese contained in specific lots from one manufacturer as the source of the outbreak. A matched case-control study was begun on 30 March 1998 to further test the hypothesis that infection with SE phage type 8 was associated with eating the commercial lunch products. A case was defined as a resident of St. John's region who, after 15 February 1998, had SE phage type 8 isolated from a stool sample. Age- and sex-matched controls were recruited by school class lists or by case nomination. Potential controls who had experienced diarrhea, abdominal cramps, fever and/or vomiting since 15 February 1998 were excluded. Data collection, with trained interviewers administering a standard questionnaire to cases and controls, occurred between 30 March and 8 April 1998. The questionnaire gathered demographic data and exposure histories (food, travel, and pet). In order to minimize the misclassification of exposure to any one brand of commercial lunch products, all study participants were asked to identify the commerical lunch products from colour photocopies of the available product packages.

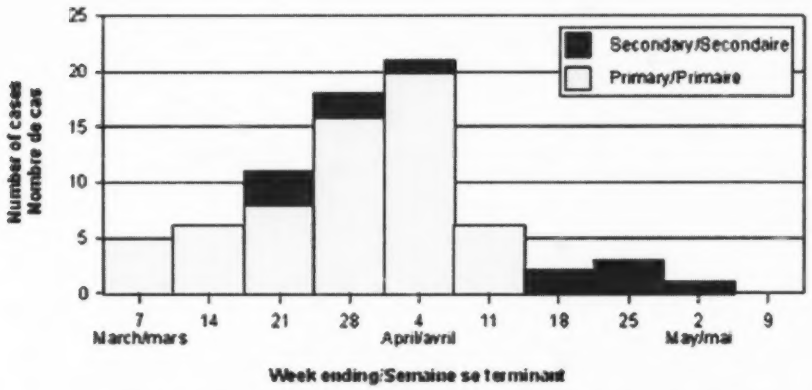
On 31 March 1998, the manufacturer voluntarily initiated a recall of the incriminated lots of its lunch pack products. The PHL processed a total of 221 samples of the lunch products in question from 1 April to 3 April 1998 and confirmed the source of the outbreak. SE isolates from clinical cases and the incriminated lunch products were found to have an identical profile by pulsed-

field gel electrophoresis. The PHL also isolated *Hafnia alvei* from four other lots of the incriminated lunch pack products on 28 March 1998.

The case-control study included 15 cases and 15 controls. Cases ranged in age from 3 to 26 years (median: 10 years). Results supported the laboratory evidence: infection with SE phage type 8 was associated with consuming the incriminated commercial lunch products within 5 days of onset of symptoms (odds ratio, undefined; p = 0.023). Infection was not associated with consuming other brands of commercial lunch products, nor with other potential exposures.

A total of 80 cases of SE phage type 8 was recognized during the outbreak; 62 cases were primary and 18 secondary, including 37 males and 43 females. The date of onset was known for 72 of the 80 cases (Figure 1). While the outbreak was province-wide, the majority of cases occurred in the St. John's region. The age group distribution of the 62 primary cases was as follows: 1 to 10 years, 34 (54.8%); 11 to 15 years, 22 (35.5%); and > 15 years, six (9.7%). The incidence was 5.5/10,000 children < 15 years of age. The incubation period in eight cases was longer than usual, ranging from 7 to 9 days. Environmental health officers with the Government Service Centre conducted recall effectiveness inspections, which concluded that the recalled products were removed from retail shelves within 24 to 72 hours of notification. The last recorded primary cases occurred on 11 April 1998. However, secondary cases prolonged the outbreak for several more days (Figure 1).

Figure 1 Incidence of *Salmonella Enteritidis* by date of onset - Newfoundland*



* Based on 72 cases with known date of onset/Basée sur 72 cas dont la date d'apparition est connue

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Comments

The laboratory-based surveillance system in the province helped identify this outbreak promptly. Such a system may be especially sensitive in rapid recognition of incident cases in a small population such as that of Newfoundland. During this outbreak, there were three additional cases of SE in the province but of different phage types, hence considered to represent sporadic incident cases unrelated to the outbreak. Although *H. alvei* has been incriminated in human diarrhea illness [1,2], it was not known whether the *H. alvei* contamination of the lunch pack products was an isolated instance or

whether it had any significance in the outbreak. Health officials in Newfoundland were quick to respond to the outbreak with a high degree of coordination. Prompt outbreak investigation, coupled with excellent cooperation and communication at all levels and between different provincial and federal agencies, played a crucial role; through this combined effort, it was possible to bring the outbreak under control within a short time.

Acknowledgements

The efforts and contribution of numerous individuals at the provincial and national levels are greatly appreciated and acknowledged.

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Source:

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Editorial Comment

The outbreak described in Newfoundland was part of a nationwide outbreak of *Salmonella* Enteritidis (SE) phage type 8 associated with contaminated cheddar cheese contained in prepackaged lunch products. This was one of the largest *Salmonella* outbreaks reported in Canada. As with many foodborne outbreaks linked to widely distributed products, the increase in SE cases was recognized in several jurisdictions independently before it was identified as an interprovincial problem. This investigation highlights the need to enhance ongoing, real-time, national enteric disease surveillance, and timely information sharing among provincial and federal health authorities. Provincial and Health Canada initiatives are underway to address these surveillance needs, including the National Health Surveillance Infostructure program. The Laboratory Centre for Disease Control's (LCDC) ***Infectious Diseases News Brief*** played an important role in relaying information to the public-health community.

SE is one of the most common *Salmonella* serotypes causing human morbidity and mortality in many countries[1, 2] including Canada where the number of SE infections recorded by LCDC has increased from 307 in 1983 to 1,255 in 1994 (unpublished data). SE is the second most common serotype found in human isolates in Canada, and 40% are phage type 8. The distribution of phage types varies among countries with phage type 4 being predominant in the United Kingdom and phage types 8 and 13-a being predominant in North America[3]. Outbreaks of SE have been frequently linked to consumption of foods containing, or cross-contaminated by, raw or undercooked eggs[3-6], for example, ice cream, lemon meringue pie, sandwich fillings, hollandaise sauce, and homemade mayonnaise[7-11]. In addition, there are reports of SE outbreaks linked to infected food handlers[12], and the rare report of

environmental contamination as the source[13].

Pasteurized cheddar cheese has not been previously linked to SE outbreaks. However, there have been several reports of large cheese-associated outbreaks of other *Salmonella* serotypes including Typhimurium, Heidelberg, Oranienburg, Javiana, Berta, Dublin, and Paratyphi[14-19]. In almost every outbreak, the cheese was made from unpasteurized milk or was contaminated by raw milk during processing. The latter was the finding in a large Canadian outbreak of *Salmonella* Typhimurium in 1984; it involved cheddar cheese manufactured from pasteurized and heat-treated (unpasteurized) milk[14]. Pathogens may be shed into the milk directly by the cow or can be introduced by environmental contamination. While persistent shedding of SE from a cow has been reported[20], this is an uncommon pathogen to find in raw milk. Poor sanitation in a cheese processing plant was the reported cause of a multistate outbreak of *S.* Oranienburg and Javiana in 1989[16].

Salmonellae have been shown to survive in ripening cheddar cheese for 7 to 10 months, depending on the temperature[14, 21]. Even low numbers of *Salmonella* bacteria have been found to cause illness in several outbreaks where quantitative analysis has been conducted[22, 23]. The bacteria are believed to be protected from stomach acids by the high fat content of the cheese[14]. Rigorous sampling is usually required to identify pathogens in cheese because of the heterogenous distribution of the bacteria in the food. Since cheese is a ready-to-eat product and even a small amount of contamination may pose a risk to human health, it is essential to ensure high safety standards for these products.

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INCIDENCE OF FOODBORNE ILLNESSES - FOODNET, 1997

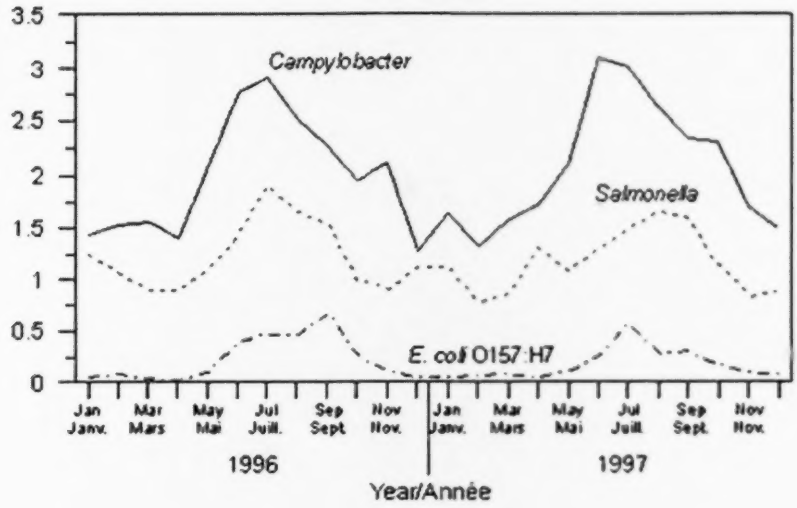
Each year, millions of persons become ill from foodborne diseases, though many cases are not reported. The Foodborne Diseases Active Surveillance Network (FoodNet), the primary foodborne diseases component of the United States Centers for Disease Control and Prevention (CDC) Emerging Infections Program[1], was developed to better characterize, understand, and respond to foodborne illnesses in the United States. This report describes FoodNet surveillance data from 1997, the second year of surveillance, and compares findings with data from 1996. The findings demonstrate regional and seasonal differences in the reported incidence of certain bacterial and parasitic diseases, and that substantial changes occurred in the incidence of illnesses caused by some pathogens (e.g. *Vibrio* and *Escherichia coli* O157:H7) but the overall incidence of illness caused by the seven diseases under surveillance in both years changed little.

Active bacterial surveillance for laboratory-confirmed cases of *Campylobacter*, *E. coli* O157:H7, *Listeria, Salmonella, Shigella, Vibrio*, and *Yersinia* infections was initiated on 1 January 1996 in Minnesota, Oregon, and two counties in California, three in Connecticut, and eight in Georgia (expanding to 20 counties in 1997). In 1997, surveillance for laboratory-confirmed cases of *Cryptosporidium* and *Cyclospora* infections was added statewide in Minnesota, Connecticut, and eight counties (including the two counties with bacterial surveillance) in California. To identify cases, surveillance personnel contacted each clinical laboratory in their catchment areas either weekly or monthly, depending on the size of the clinical laboratory. Annual incidence was calculated using the number of laboratory-confirmed cases ascertained in the catchment area as the numerator and 1997 postcensus estimates in the same areas as the denominator[2]. Monthly incidence was calculated based on date of specimen collection.

1997 surveillance data

In 1997, 8,576 laboratory-confirmed cases were identified: 3,974 of campylobacteriosis, 2,205 of salmonellosis, 1,273 of shigellosis, 468 of cryptosporidiosis, 340 of *E. coli* O157:H7 infections, 139 of yersiniosis, 77 of listeriosis, 51 of *Vibrio* infections, and 49 of cyclosporiasis. Seasonal variation in isolation rates was seen for several pathogens; 52% of *E. coli* O157:H7, 35% of *Campylobacter*, and 32% of *Salmonella* were isolated in summer months (June to August) (Figure 1). Organisms were isolated from normally sterile sites, including blood and cerebrospinal fluid, in 99% of reported *Listeria* cases, 7% of *Salmonella* cases, 3% of *Yersinia* cases, and 1% of *Shigella* and *Campylobacter* cases. Overall, 1,270 (15%) of 8,576 patients with laboratory-confirmed infections were hospitalized; the proportion of persons with cases hospitalized was highest for listeriosis (88%), *E. coli* O157:H7 infections (29%), and salmonellosis (21%). Thirty-six patients with laboratory-confirmed infections died: 15 with *Listeria*, 13 with *Salmonella*, four with *E. coli* O157:H7, two with *Cryptosporidium*, one with *Campylobacter*, and one with *Shigella*.

Figure 1 Monthly incidence* of selected pathogens - FoodNet, 1996-1997**



* Per 100,000 population.
** Laboratory-confirmed cases of Campylobacter, Escherichia coli O157:H7, and Salmonella infections were identified in Minnesota, Oregon, and selected counties in California (two), Connecticut (three), and Georgia (eight in 1996 and 20 in 1997).

All-site incidence was highest for campylobacteriosis (24.7 per 100,000 population), salmonellosis (13.7), and shigellosis (7.8). The incidence of campylobacteriosis varied from 13.7 in Georgia to 49.3 in California. Although overall salmonellosis incidence was similar among the sites, the incidence of infections with *Salmonella* serotype Enteritidis varied, from 0.6 in Georgia to 5.8 in Connecticut. Shigellosis incidence varied from 2.9 in Minnesota to 15.9 in Georgia. Incidence differed by site for *E. coli* O157:H7 infections and yersiniosis; *E. coli* O157:H7 infections varied from 0.2 in Georgia to 4.2 in Minnesota, and yersiniosis varied from 0.5 in Oregon to 1.2 in Georgia.

Annual incidence also varied by age; for example, the incidence among children aged < 1 year was 56 per 100,000 for campylobacteriosis (range: 18 in Georgia to 159 in California) and 111 per 100,000 for salmonellosis (range: 66 in Oregon to 174 in California).

Comparison with 1996 surveillance data

Overall, incidence of illness caused by the pathogens under surveillance changed little from 1996 to 1997 (Table 1). The largest percentage change occurred in cases of illness caused by *Vibrio* (from 0.1 in 1996 to 0.3 in 1997). *E. coli* O157:H7 showed the next largest percentage change (from 2.7 to 2.1, a decrease of 27%). From 1996 to 1997, Minnesota and Oregon reported an overall increase in the incidence of illnesses caused by the pathogens under surveillance; California, Connecticut, and Georgia reported decreases.

Table 1 Incidence* of selected pathogens, by year - FoodNet**

Organism	All sites	
	1996	1997
Campylobacter	23.5	24.7
Escherichia coli O157:H7	2.7	2.1
Listeria	0.5	0.5
Salmonella	14.5	13.7
Shigella	8.9	7.9
Vibrio	0.1	0.3
Yersinia	1	0.9
Cryptosporidium	***	2.8
Cyclospora	***	0.3
Total	**51.2**	**50.1****

* Per 100,000 population.

** In 1996, laboratory-confirmed cases of *Campylobacter*, *Escherichia coli* O157:H7, *Listeria*, *Salmonella*, *Shigella*, *Vibrio*, and *Yersinia* infections were identified in Minnesota, Oregon, and two counties in California, three in Connecticut, and eight in Georgia (expanding to 20 in 1997). In 1997, surveillance for laboratory-confirmed cases of *Cryptosporidium* and *Cyclospora* infections was added statewide in Minnesota and Connecticut and in eight counties (including the two counties with bacterial surveillance) in California.

*** Not reported in 1996.

**** Excludes *Cryptosporidium* and *Cyclospora*.

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Announcement

CANADIAN INTERNATIONAL IMMUNIZATION INITIATIVE - SHORT-TERM ASSIGNMENTS

The Canadian Public Health Association (CPHA) has been contracted by the Government of Canada to implement the technical assistance component of the new Canadian International Immunization Initiative (CIII). Through the Initiative, CPHA will identify and recruit Canadian technical consultants to assist WHO and UNICEF strengthen national childhood immunization systems towards eradicating polio, eliminating measles, and combating childhood diseases in non-industrial countries and in Eastern and Central Europe. The CIII, a partnership between the Canadian International Development Agency, CPHA, UNICEF Canada, WHO, Canadian Rotarians, and other collaborating Canadian NGOs, renews the Canadian Government's international commitment to one of the most cost-effective public-health measures - childhood immunization.

Building on the many lessons learned from CPHA's experience working at the forefront of strengthening immunization programs in non-industrialized countries, CPHA is reaching out to the Canadian public-health community to identify expertise to fulfill short-term assignments with WHO and UNICEF. These assignments may vary from 2 weeks to several months and will be directed towards specific assistance in areas of disease surveillance, program planning and delivery, human resource development, vaccine management, and laboratory strengthening. There may also be other areas of Canadian expertise which will emerge as the program develops. The priority countries will include those in greatest need in sub-Saharan Africa, Asia, and some European countries in transition.

For more information on this initiative, please contact the **CPHA, 400-1565 Carling Avenue, Ottawa ON, K1Z 8R1: FAX 613-725-9826, e-mail<ciii@cpha.ca>.**

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1997-1998 INFLUENZA SEASON: CANADIAN LABORATORY DIAGNOSES AND STRAIN CHARACTERIZATION

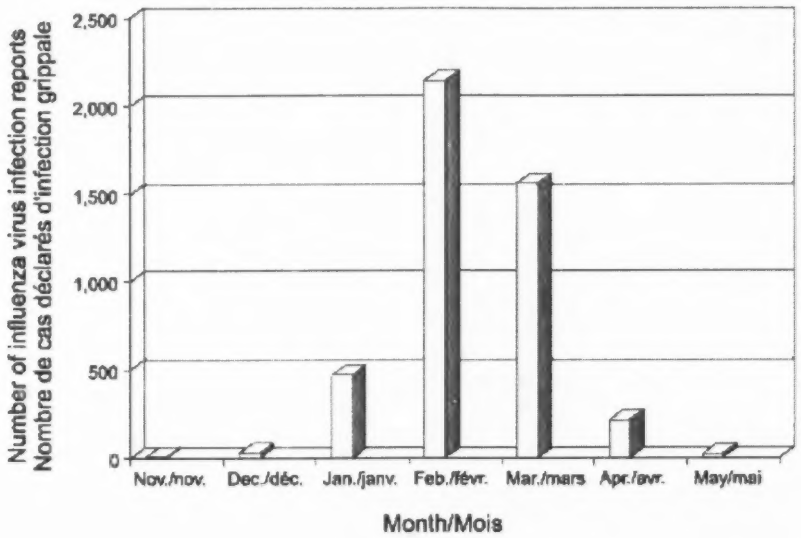
Introduction

In collaboration with the World Health Organization (WHO) international collaborating laboratories, provincial laboratories, and other Canadian hospital and university-based laboratories, the Laboratory Centre for Disease Control (LCDC) conducts national surveillance to monitor influenza activity and to detect antigenic changes in the circulating strains of influenza viruses. Canadian influenza surveillance information and actual representative strains are then shared with the WHO's collaborating centres for influenza to contribute to global influenza monitoring. This report summarizes influenza surveillance in Canada for the 1997-1998 influenza season.

Influenza Activity

The 1997-1998 influenza season in Canada began in early November 1997 and continued until May 1998. During this period, there were 4,470 cases of laboratory-confirmed influenza infections reported to LCDC by laboratories that contribute to the Canadian Virus Reporting (CVR) program, a surveillance program covering all laboratory-diagnosed viral infections. Figure 1 shows the numbers of and the months of laboratory-confirmed influenza virus isolations, detections, and serodiagnoses. Of the 4,470 reports, 4,441 (99.4%) were influenza type A, with the peak (2,139) occurring in February. There were only 29 (0.6%) cases of influenza type B (not shown in Figure 1). These data indicated that influenza A viruses predominated during the 1997-1998 season, with peak activity between January and March (Figure 1). This is in contrast to the 1996-1997 influenza season, in which both influenza type A and B viruses (1,953 and 1,173 reports, respectively) prevailed in Canada[1]. Furthermore, the level of activity of type A viruses in the 1997-1998 season appeared to be relatively higher than those of the previous 5 years[1].

Figure 1 Laboratory-confirmed influenza virus infections in Canada during the 1997-1998 season



Strain Characterization

During the 1997-1998 influenza season, 441 influenza virus isolates (440 of influenza A and one of influenza B) were submitted to LCDC for strain typing and subtyping analysis. Of the 440 subtyped influenza A isolates, 432 (98%) were H3N2 and eight (2%) were H1N1 (Figure 2 and Table 1). Among the 432 H3N2 isolates, 71 (16%) were similar to A/Wuhan/359/95, the strain included in the 1997-1998 influenza vaccine[(2)], and 361 (82%) were similar to A/Sydney/05/97, a related but antigenically distinguishable variant of A/Wuhan/359/95 (Table 1). The proportion of influenza strains that were A/Sydney/05/97-like rapidly increased from January through April: 72% (41 of 57) in January, 80% (107 of 133) in February, 87% (139 of 160) in March, and 92% (70 of 76) in April (Figure 1). Only one type B isolate was submitted to LCDC, and was similar to the 1997-1998 vaccine component strain B/Beijing/184/93. All of the eight H1N1 isolates were characterized as A/Texas/36/91-like, which is antigenically different from the vaccine component strains A/Johannesburg/82/96 and A/Bayern/07/95. Table 1indicates the provincial source and identity of submitted isolates.

Figure 2 Antigenic characterization completed on influenza virus isolates in the 1997-1998 season, by month of submission

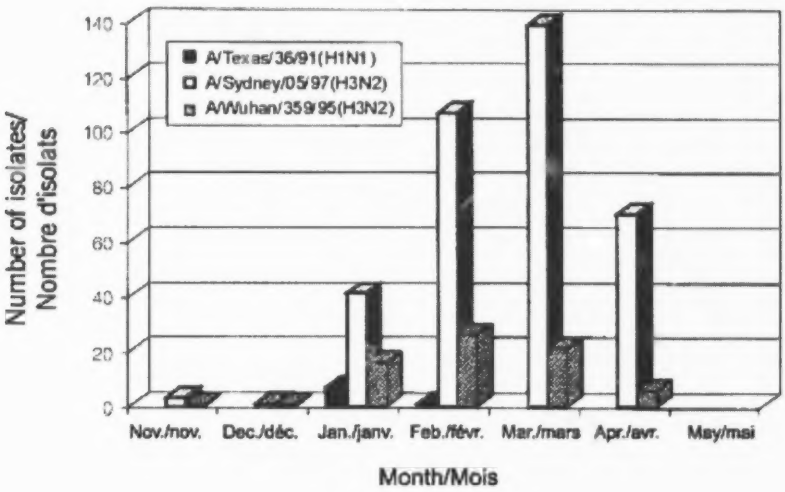


Table 1 Strain characterization completed on influenza isolates in Canada, submitted from November 1997 to 6 May 1998

Influenza	Province										TOTAL
	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	
TYPE A(H1N1)											
A/Texas/36/91-like											
* A/Johannesburg/82/96-like						8					8
TYPE A(H3N2)											
** A/Wuhan/359/95-like			7	1	32	19		4	7	1	71
*** A/Sydney/5/97-like	10	4	6	4	41	198	14	38	37	9	361
TOTAL A	**10**	**4**	**13**	**5**	**73**	**225**	**14**	**42**	**44**	**10**	**440**
TYPE B											
****B/Beijing/184/93						1					1
TOTAL B						**1**					**1**
TOTAL	**10**	**4**	**13**	**5**	**73**	**226**	**14**	**42**	**44**	**10**	**441**

* A/Johannesburg/82/96-like virus is similar to A/Bayern/7/95, the WHO recommended H1N1 strain for the 1997-1998 influenza vaccine.
** A/Wuhan/359/95-like virus is the WHO recommended influenza A(H3N2) component of the 1997-1998 influenza vaccine.
*** A/Sydney/5/97-like virus is related but antigenically distinguishable from A/Wuhan/359/95-like(H3N2).
**** B/Beijing/184/93-like virus is the WHO recommended influenza B component of the 1997-1998 influenza vaccine and is antigenically indistinguishable from B/Harbin/7/94.

Consistent with antigenic analysis, genetic characterization of 20 Canadian A/Sydney/05/97-like isolates, which were collected from across Canada during the first half of the 1997-1998 influenza season, confirmed the antigenic

difference between Canadian A/Sydney/05/97-like isolates and the 1997-1998 H3N2 vaccine component strain A/Wuhan/359/95[3].

Discussion

The 1997-1998 season was dominated by influenza A viruses (99.4%) and, during this season, the highest number of laboratory-confirmed cases (4,470) was recorded by LCDC for any winter in the period 1978-1997[4]. This increase in cases was not due to an increase in reporting laboratories; 40 laboratories participated in CVR in this season compared to 42 in the previous one[1].

Strain characterization showed that two antigenetically-related but distinguishable strains of influenza A(H3N2) viruses, A/Wuhan/359/95-like and A/Sydney/05/97-like, co-circulated in Canada during the 1997-1998 influenza season; the A/Sydney/05/97-like strain was predominant. Whereas, in the previous season, all of the characterized isolates of influenza A and B were antigenically similar to the vaccine component strains[1]. The A/Sydney/05/97-like strain also caused considerable morbidity and mortality in Canada and the United States[2,5]. Identification of the new strain of influenza A(H3N2) virus, A/Sydney/05/97-like, in Canada further emphasizes the importance of timely submission of influenza isolates for antigenic characterization.

Similar trends were observed worldwide; influenza A(H3N2) viruses were mostly identified as A/Sydney/05/97-like in many countries, suggesting that the 1997-1998 vaccine component, A/Wuhan/359/95, provided only limited protection to vaccinated individuals[2]. Influenza A(H1N1) and influenza B viruses were isolated only sporadically during the 1997-1998 influenza season in many countries, including Canada. Most influenza B isolates were similar to B/Beijing/184/93 and the 1997-1998 vaccine component strain B/Harbin/07/94. Although influenza A(H1N1) viruses were isolated in a number of countries during the 1997-1998 influenza season, an increasing number of antigenically characterized isolates showed variation from the vaccine component strain A/Bayern/07/95 but were close to A/Beijing/262/95 that was identified recently in several countries in other continents.

Current vaccines containing B/Harbin/07/94 induced antibodies with similar frequency and titre to the vaccine viruses and to recently isolated B/Beijing/184/93-like strains. However, vaccines containing A/Wuhan/359/95-like(H3N2) and A/Bayern/07/95-like(H1N1) viruses induced good antibody responses to the vaccine strains, but less frequent and reduced antibody responses to recent isolates such as A/Sydney/05/97 and A/Beijing/262/95[2,6]. Therefore, WHO recommended the following strains as vaccine components for the 1998-1999 season[6]:

- A/Sydney/05/97-like(H3N2)
- A/Beijing/262/95-like(H1N1), and
- B/Harbin/07/94-like.

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The collaboration of laboratories in the CVR program and of provincial and hospital laboratories that forwarded early and representative isolates of influenza virus is a vital part of influenza surveillance in Canada.

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Vancouver BC;
- Virology and Reference Laboratory, U.B.C., Vancouver BC;
- Provincial Laboratory of Public Health for Southern Alberta, Calgary AB;
- Provincial Laboratory of Public Health for Northern Alberta, Edmonton AB;
- Royal University Hospital, Saskatoon SK;
- Saskatchewan Public Health Laboratory, Laboratory and Disease Control Services Branch, Regina SK;
- Cadham Provincial Laboratory, Winnipeg MB;
- Hospital for Sick Children, Toronto ON;
- Regional Public Health Laboratory, Laboratory Services Branch, Virus Laboratory, Toronto ON;
- Regional Public Health Laboratory, Peterborough ON;
- University of Guelph, Guelph ON;
- Regional Public Health Laboratory, Kingston ON;
- Regional Public Health Laboratory, Orillia ON;
- Children's Hospital of Eastern Ontario, Ottawa ON;
- Regional Public Health Laboratory, Ottawa ON;
- Regional Public Health Laboratory, Sault Ste. Marie ON;
- Regional Public Health Laboratory, Timmins ON;
- Regional Public Health Laboratory, Thunder Bay ON;
- *Laboratoire de santé publique du Québec*, Sainte-Anne-de-Bellevue QC;
- *Centre hospitalier St-Joseph*, Trois-Rivières QC;
- *Hôpital G. L. Dumont*, Moncton NB;
- Victoria General Hospital, Halifax NS;
- Newfoundland, Labrador Public Health Laboratory, St. John's NF.

Carol Stansfield of LCDC conducted the influenza strain typing.

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